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## Study on Superheated Steam Drying Combined with Microwave Heating of Porous Material Containing NaCl Aqueous Solution

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### Summary

Materials such as food or chemical products contain water in which some water-soluble solute is dissolved. However, no studies on the superheated drying of materials containing a water-soluble solute combined with microwave heating have been reported thus far.

In this study, a spherical porous material (diameter: 30 mm) containing an NaCl aqueous solution was used as a sample material. The material temperature and moisture changes were measured continuously during drying using hot air, high humid air, and superheated steam as drying media. In addition, the effects of microwave irradiation and the amount of superheated steam in the drying media on the heat and mass balance during drying, drying time, and energy efficiency were investigated. These were also compared with the results for a material containing pure water. The flow velocity and temperature were 1 m/s and 160 °C, respectively, and microwaves were irradiated for 360 s from 360 s to 720 s during the experiment.

In the case of drying a material containing pure water with superheated steam, the material temperature increased to 100 °C by steam condensation before microwave irradiation. Subsequently, the temperature increased to 110 °C immediately, then decreased gradually to 100 °C, and the moisture content also decreased due to water evaporation and detached droplets during microwave irradiation. On the other hand, in the case of the porous material containing the NaCl aqueous solution, the material temperature was maintained virtually constant around 102 °C during and after microwave irradiation. The detached droplets from the material containing the NaCl aqueous solution were observed only in superheated steam, the total mass of the droplets was less than that in the case of the material containing pure water. The microwave irradiation has a significant effect in that it leads to a reduction in the drying time and energy consumption of open-type superheated steam drying.